SALMONELLA SEROLOGY COMPARED TO BODY WEIGHT FOR FINISHERS AND SOWS

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Abstract The relation between live body weight and *Salmonella* OD% for meat juice samples was investigated for finishers. The result was a seagull shaped curve indicating that the risk of being seropositive declines with increasing body weight from 60 to approximately 100 kilos and then rises again. The seagull curve is thought to be a combination of different trends: 1) A declining seroreaction caused by early *Salmonella* infection and 2) A higher background level of cross-reacting antibodies with increasing age, induced by other Enterobactericeae. A study of 414 sows at slaughter revealed a significantly higher seroprevalence among sows than among finishers. This is probably caused by the continuous housing system resulting in repeated boosting of *Salmonella* antibodies. The relatively low bacteriological *Salmonella* excretion rate among sows indicates that the higher seroprevalence among sows is not necessarily reflecting a higher level of *Salmonella* excretion among sows.

Introduction The purpose of the present study was to investigate the connection between *Salmonella* serology and live body weight (LBW) in pigs at slaughter and to test the seroprevalence among sows in comparison to finishers. The vast majority of finishers are slaughtered at a LBW close to 100 kilos, but the LBW varies from under 80 to more than 130 kilos of LBW at slaughter. Serological data and carcass weight for finishers was recorded in a central register. For sows, serological data and LBW (140-300 kilos) were recorded in a pilot study.

Materials and Methods According to the Danish surveillance and control program (Nielsen *et al.* 2001), 572,096 finishers were randomly selected for meat juice sampling in 2004. By using the public Zoonoses Register in the national Danish Central Herd Register, the carcass weight, and individual number for 542,270 of the finishers from the 17 largest slaughterhouses was obtained. The carcass weight was transformed into LBW with the formula: LBW = Carcass weight x 1.19 + 7.01 (Personal comm., Danish Crown, 2005).

In a cross-sectional study, blood samples from 550 sows were taken at a slaughterhouse. The carcass weight was recorded for 414 sows. For sows, the LBW corresponds to carcass weight x 1.28 (Personal comm., Danish Crown, 2002).

All meat juice and blood samples were analysed for *Salmonella* antibodies in the mix-ELISA used in the surveillance program (Nielsen *et al.*, 1995), and the results were expressed as OD% (Nielsen *et al.*, 1998).

The dependency of *Salmonella* serology on LBW and thus indirectly age, (Vestergaard, unpublished results) was studied using partly the OD% as observed and partly the dichotomized values obtained by applying two cut-off values used in practice (20 OD% and 40 OD%). The use of a cut-off corresponds to the state of each animal being regarded as 'positive' or 'negative'.

For the analysis of OD%, simple quadratic regression was used to obtain an OD% versus LBW curve. Likewise the slope in both sides of the curve could be tested. For the analysis of positive/negative results, logistic regression was applied in the analogous way. The effect of sow versus finisher was evaluated using a two-level indicator.

Results The correlation between OD% and LBW for finishers is a seagull shaped curve (figure 1). Finishers with LBW much lower or higher than 100 kg have significantly higher OD%-values compared to finishers of average LBW (p-value < 0.0001). The lowest OD% corresponds to 102 kilos LBW, very close to 101 kilos, which is the average LBW at slaughter for Danish finishers. For sows, a plot of the OD% versus LBW showed no clear correlation (figure 1). Figure 2 shows a plot of seroprevalence against LBW for sows and finishers where 20 OD% is used as the cut-off. In this plot the seagull shape for finishers is even clearer (figure 2). However, at cut-off 20 OD% the seroprevalence for small sows (140-200 kilos LBW) was significatly higher than seroprevalence for large finishers of comparable LBW (130-150 kilos) (p-value <0,0001) (figure 2).

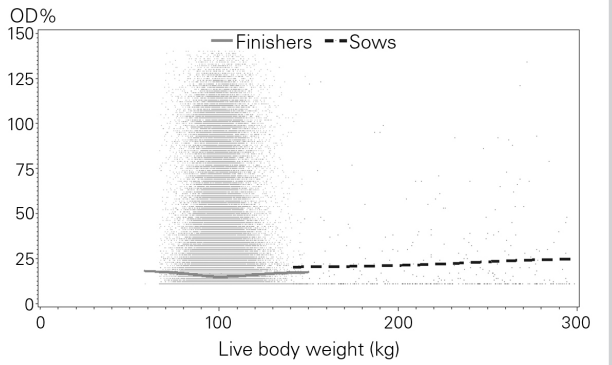

Figure 1. A plot of OD% against live body weight for finishers and sows. OD%-values from sows below 11 were set to 11 in order to compare with the finishers, where OD%-values below 11 are excluded by the laboratory. The curves represent the weight specific means for finishers and sows respectively.

Discussion The seagull-shaped serology curve for finishers is apparently not a 2004 phenomenon. Danish data from 2001 looks very much the same apart from small displacements (Unpublished data). For finishers, the declining seroprevalence in the weight interval 60-100 kilos (left wing of the seagull curve) could be explained by the expected decline in antibody level by age, indicated by body weight (Kranker *et al*. 2003). However, the rise in seroprevalence in the weight interval 100-150 kilos (right side of the seagull curve) was difficult to explain, because it was assumed that management factors did not differ for finishers in the weight interval 60-150 kilos. A partial explanation could be a higher background level of cross-reacting antibodies with increasing age, induced by other Enterobactericeae (*E. coli, Yersinia and Citrobacter*) (Nielsen *et al*.1995). The fact that the average LBW at slaughter corresponds to minimal *Salmonella* serological values is an interesting coincidence.

For sows, our data are parallel displaced to a significantly higher level compared to finishers (figure 2). This is probably caused by the continuous housing systems for sows, resulting in repeated reinfections with *Salmonella* and boosting of *Salmonella* antibodies. Our data show that increasing sow body weight, as an expression of age or parity, does not result in a higher seroprevalence at cut-off 20 OD%.

Very few studies have looked at the association between *Salmonella* bacteriology and serology in sows. In Denmark, a relatively low *Salmonella* excretion rate among sows has been found previously (Nielsen, unpublished results; Kranker *et al.*, 2003), indicating that the higher seroprevalence among sows is not necessarily an expression of more *Salmonella* excretion among sows than among finishers.

Conclusions For Danish finishers, the *Salmonella* serology is related to body weight. The *Salmonella* OD% was lowest around 100 kilos LBW and slightly higher with increasing or decreasing body weight. Sows have significantly higher *Salmonella* seroprevalence than finishers, but for the sows no significant correlation to LBW was found.

References

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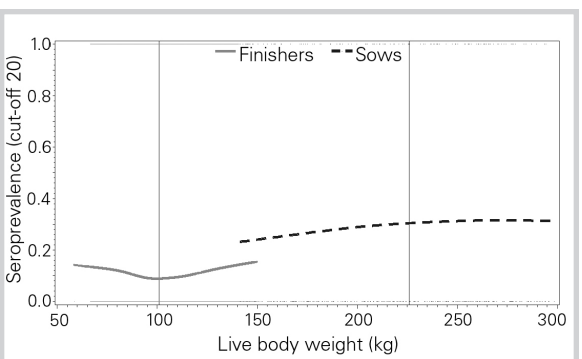

Figure 2. A plot of seroprevalence against live body weight (60 to 300 kilos) for finishers and sows at cut-off 20 OD%. The vertical lines close to the center of the two curves represent the overall average LBW at slaughter for finishers and the average LBW in the pilot project for sows.